

3D Audio System



Shown **below** is the Convolvotron, a very high speed digital audio processing system that delivers three-dimensional sound over headphones. Marketed by Crystal River Engineering, Inc., Groveland, California, the signal processor was designed by the company's president, Scott H. Foster, as part of an auditory research program conducted by Elizabeth Wenzel of Ames Research Center's Human Factors Division.

The Convolvotron consists of a two-card set designed for use with a personal computer. The system's 128 parallel processors make the Convolvotron 20 times faster than ordinary digital signal processing systems, the company states.

Programmed for a variety of signal processing tasks, the Convolvotron's primary application is presentation of 3D audio signals over headphones. In this application, four independent sound sources are filtered with large, time-varying filters that compensate for the head motion of the listener or the motion of audio sources. As the listener's head changes position, the perceived location of the sound source remains constant — for example, sound perceived to come from in front of the listener will change smoothly to the right side when the listener turns 90 degrees to the left.

The Convolvotron was developed for Ames' research on virtual acoustic displays, part of the center's broader research into virtual reality, or artificial reality, displays. Ames is investigating the

possibilities of combining a 3D auditory system with visual virtual displays **below**.

The primary advantage of the Convolvotron is that it allows monitoring and identifying sources of information from all possible locations, not just "direction of gaze." This feature could be useful in an application such as an air traffic control display in control towers or airplane cockpits. A further advantage is that the 3D system improves the intelligibility of sounds and assists in the segregation of multiple sound sources. A combined visual/auditory system can reinforce the information content of the display and provide a greater sense of realism than either modality alone.

Although the Convolvotron is used mostly by government agencies and their contractors, it is also being sold commercially. It is used in research on hearing and perception; customers include Boston University, Massachusetts Institute of Technology and the University of Wisconsin. Additionally, it is used by virtual reality researchers and systems developers; customers include Fujitsu, Autodesk and Disney Imagineering. The system is also used by aircraft manufacturers; Lockheed Corporation is using it in development of an advanced aircraft cockpit. •

